What's new in Airflow 2

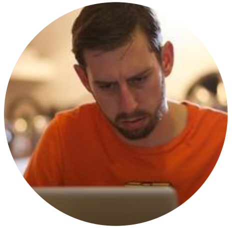
Apache Airflow Online Summit
8th of July 2020

Who are we?

Tomek Urbaszek
Committer, **PMC Member**
Software Engineer @ Polidea

Jarek Potiuk
Committer, **PMC member**
Principal Software Engineer @ Polidea

Kamil Breguła
Committer, **PMC member**
Software Engineer @ Polidea



Ash Berlin-Taylor
Committer, **PMC member**
Airflow Engineering Lead @ Astronomer

Daniel Imberman
Committer, **PMC Member**
Senior Data Engineer @ Astronomer

Kaxil Naik
Committer, **PMC member**
Senior Data Engineer @ Astronomer

Announcements

New PMC members

Tomek Urbaszek
Committer, **PMC Member**
Software Engineer @ Polidea

Daniel Imberman
Committer, **PMC Member**
Senior Data Engineer @ Astronomer

Kamil Breguła
Committer, **PMC member**
Software Engineer @ Polidea

New committer

QP Hou
Committer
Senior Engineer @ Scribd

Talk: Teaching an old DAG new tricks
Friday July 10 th, 5 am UTC

“Ask Me Anything” session with Airflow PMCs

- **Asia friendly time-zone**
- **Thursday 11 pm PDT / Friday 6 am UTC**
- **Hosted by Bangalore Meetup**
- **BYO questions**

High Availability

Scheduler High Availability

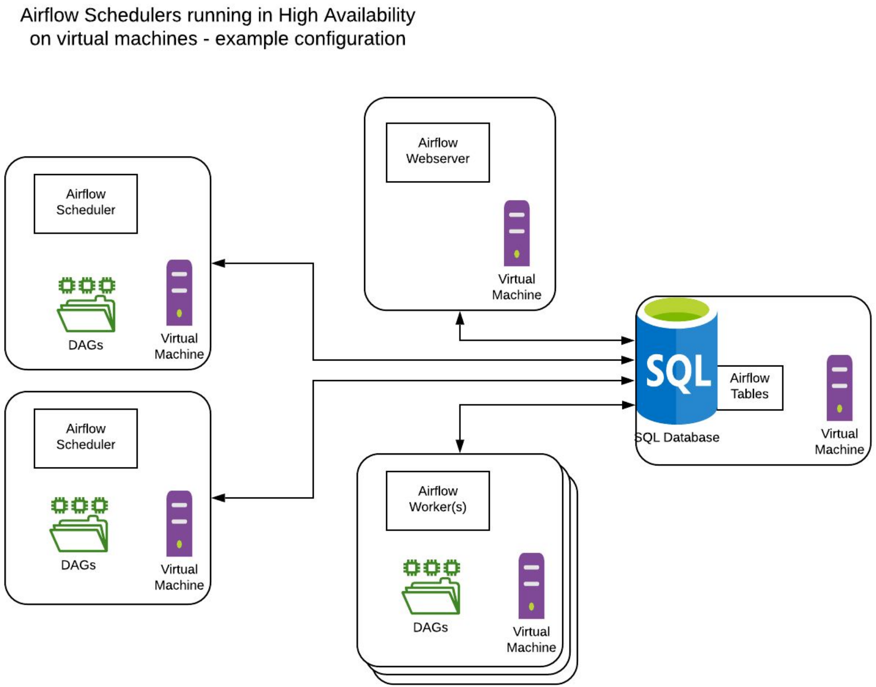
Goals:

- Performance - reduce task-to-task schedule "lag"
- Scalability - increase task throughput by horizontal scaling
- Resiliency - kill a scheduler and have tasks continue to be scheduled

Scheduler High Availability: Design

- Active-active model. Each scheduler does everything
- Uses existing database - no new components needed, no extra operational burden
- Plan to use row-level-locks in the DB (`SELECT … FOR UPDATE`)
- Will re-evaluate if performance/stress testing show the need

Example HA configuration



Scheduler High Availability: Tasks

- Separate DAG parsing from DAG scheduling ✅

  This removes the tie between parsing and scheduling that is still present

- Run a mini scheduler *in the worker* after each task is completed ✅

  A.K.A. "fast follow". Look at immediate down stream tasks of what just finished and see what we can schedule

- Test it to destruction - In progress

  This is a big architectural change, we need to be sure it works well.

Measuring Performance

Key performance we define as "Scheduler lag":

- Amount of "wasted" time not running tasks
- `ti.state_date - max(t.end_date for t in upstream_tis)`
- Zero is the goal (we'll never get to 0.)
- Tasks are "echo true" -- tiny but still executing

Preliminary performance results

Case: 100 DAG files | 1 DAG per file | 10 Tasks per DAG | 1 run per DAG

Workers: 4 | Parallelism: 64

1.10.10: 54.17s (σ19.38) Total runtime: 22m22s

HA branch - 1 scheduler: 4.39s (σ1.40) 1m10s

HA branch - 3 schedulers: 1.96s (σ0.51) Total runtime: 48s

Preliminary performance results

Case: 1 Dag File | 1 Dag Per File | 20 Tasks per DAG | 1000 runs per DAG

Workers: 30 | Parallelism: 40960 | Default pool size 40960

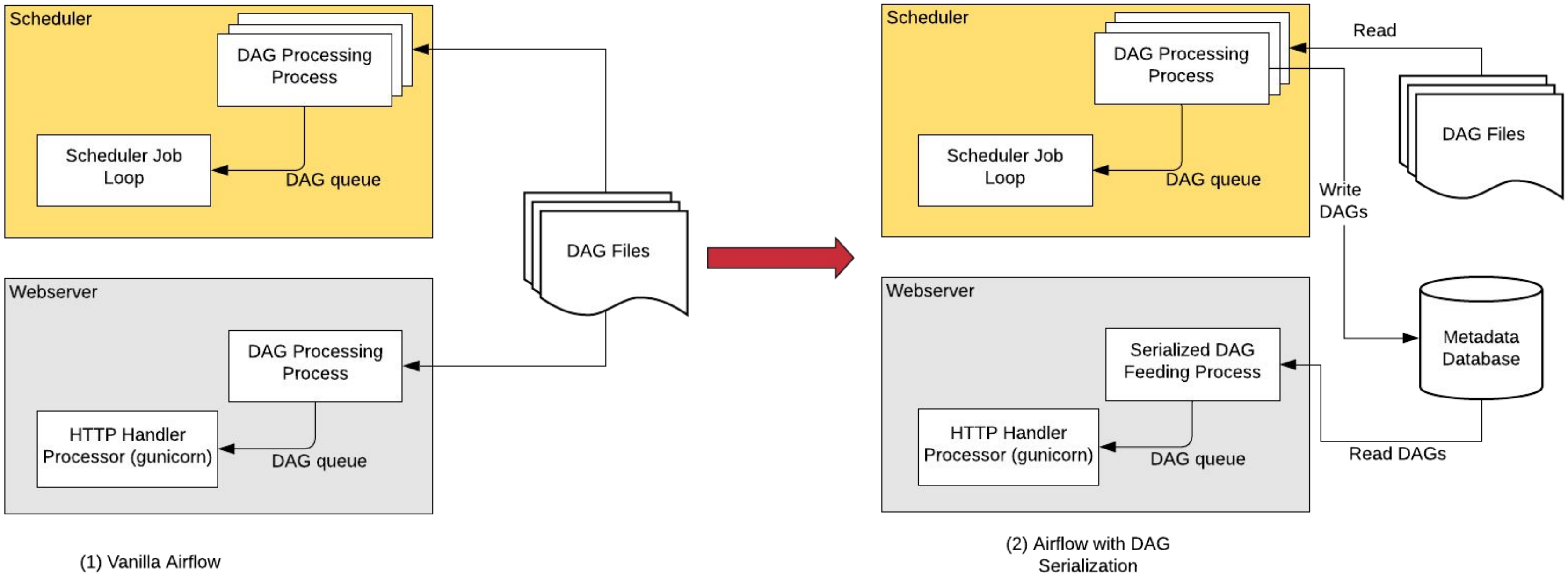
1.10.10: 42.14s (σ7.06) Total runtime: 1h 30m 14s

HA branch - 1 scheduler: 0.68s (σ0.19) Total runtime: 18m 51s

HA branch - 3 schedulers*: 1.54s (σ1.79) Total runtime: 12m 52s

DAG Serialization

Dag Serialization



Dag Serialization (Tasks Completed)

- **Stateless Webserver:** Scheduler parses the DAG files, serializes them in JSON format & saves them in the Metadata DB.

- **Lazy Loading of DAGs:** Instead of loading an entire DagBag when the Webserver starts we only load each DAG on demand. This helps **reduce Webserver startup time and memory.** This reduction in time is notable with large number of DAGs.

- Deploying new DAGs to Airflow - no longer requires long restarts of webserver (if DAGs are baked in Docker image)

- Feature to use the “JSON” library of choice for Serialization (default is inbuilt ‘json’ library)

- Paves way for **DAG Versioning** & **Scheduler HA**

Dag Serialization (Tasks In-Progress for Airflow 2.0)

- Decouple DAG Parsing and Serializing from the scheduling loop.
- Scheduler will fetch DAGs from DB
- DAG will be parsed, serialized and saved to DB by a separate component “Serializer”/ “Dag Parser”
- This should reduce the delay in Scheduling tasks when the number of DAGs are large

DAG Versioning

Dag Versioning

Current Problem:

- Change in DAG structure affects viewing previous DagRuns too
- Not possible to view the code associated with a specific DagRun
- Checking logs of a deleted task in the UI is not straight-forward

Dag Versioning (Current Problem)

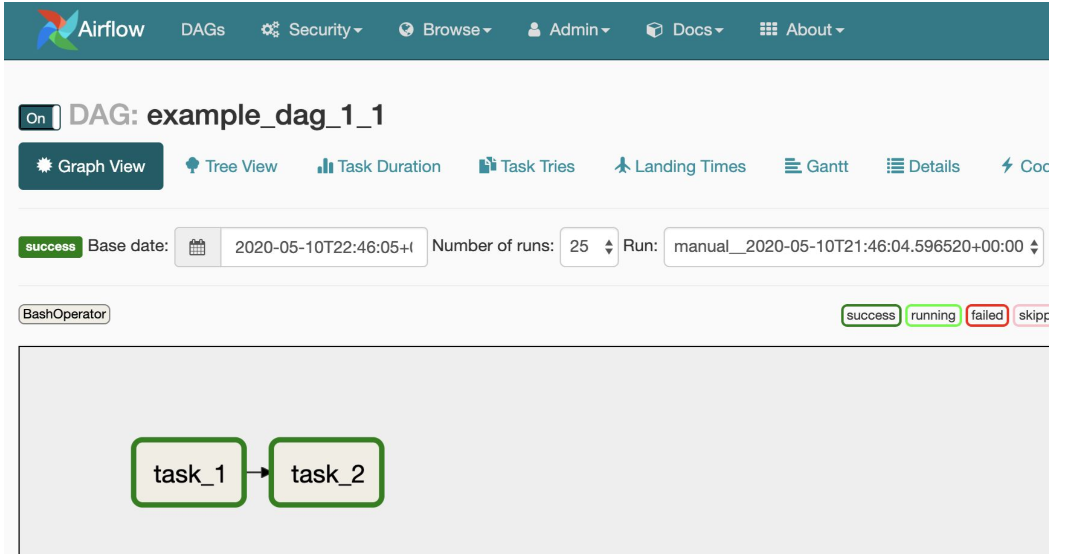
```
from airflow.models.dag import DAG
from airflow.operators.bash_operator import BashOperator
from datetime import datetime

with DAG('example_dag_1_1', schedule_interval=None,
         start_date=datetime(2020, 4, 25)) as example_dag_1_1:

    task_1 = BashOperator(
        task_id='task_1',
        bash_command='echo hello',
    )

    task_2 = BashOperator(
        task_id='task_2',
        bash_command='echo hello',
    )

    task_1 >> task_2
```



Dag Versioning (Current Problem)

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from airflow.operators.bash_operator import BashOperator
from datetime import datetime

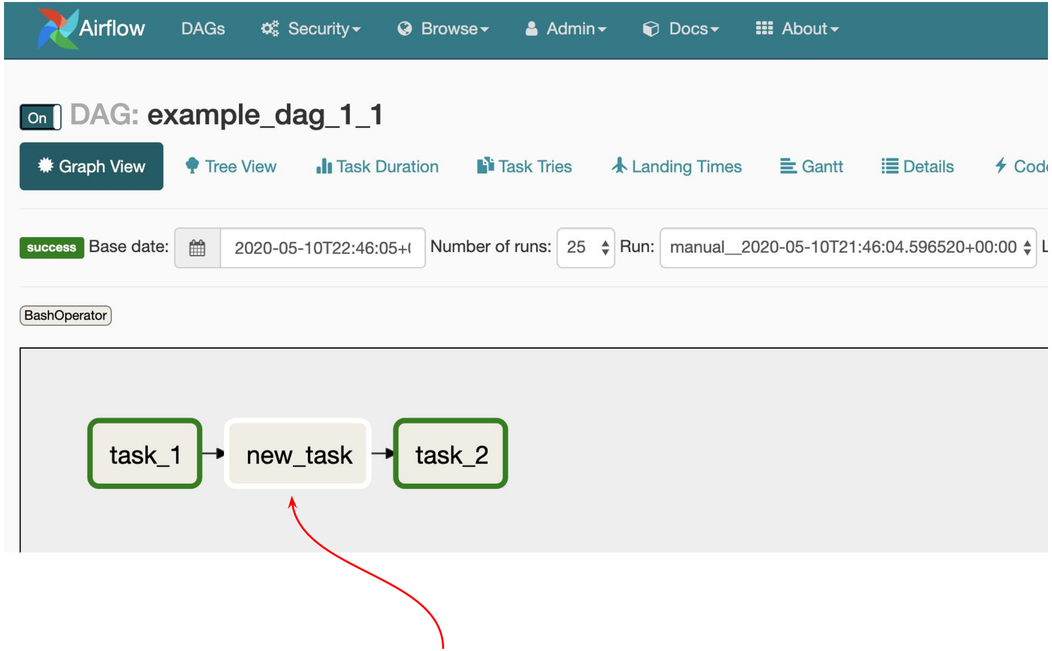
with DAG('example_dag_1_1', schedule_interval=None,
         start_date=datetime(2020, 4, 25)) as example_dag_1_1:

    task_1 = BashOperator(
        task_id='task_1',
        bash_command='echo hello',
    )

    new_task = BashOperator(
        task_id='new_task',
        bash_command='echo hello',
    )

    task_2 = BashOperator(
        task_id='task_2',
        bash_command='echo hello',
    )

    task_1 >> new_task >> task_2
```



New task is shown in Graph View for older DAG Runs too with “no status”.

Dag Versioning

Current Problem:

- Change in DAG structure affects viewing previous DagRuns too
- Not possible to view the code associated with a specific DagRun
- Checking logs of a deleted task in the UI is not straight-forward

Goal:

- Support for storing multiple versions of Serialized DAGs
- Baked-In Maintenance DAGs to cleanup old DagRuns & associated Serialized DAGs
- Graph View shows the DAG associated with that DagRun

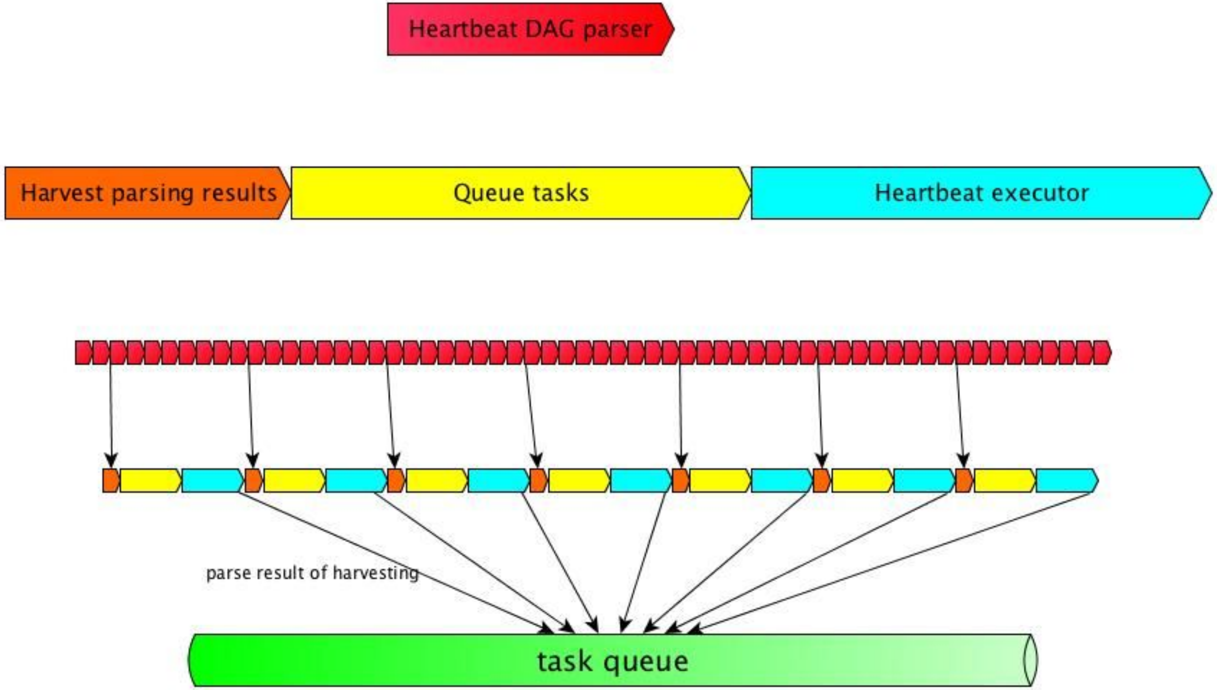
Performance Improvements

Components performance improvements

- Focus on the current code
  - Reviews each components in turn
- Tools supporting performance tests - *perf_kit*

```
@timing()
def test_dag_sync():
    with count_queries():
        DAG.bulk_sync_to_db()
```

Avoid loading DAGs in the main scheduler loop



Limit queries count

DagFileProcessor:
When we have one DAG file with 200 DAGs, each DAG with 5 tasks:

	Before	After	Diff
Average time:	8080.246 ms	628.801 ms	-7452 ms (92%)
Queries count:	2692	5	-2687 (99%)

Celery Executor:
When we have one DAG file with 200 DAGs, each DAG with 5 tasks:

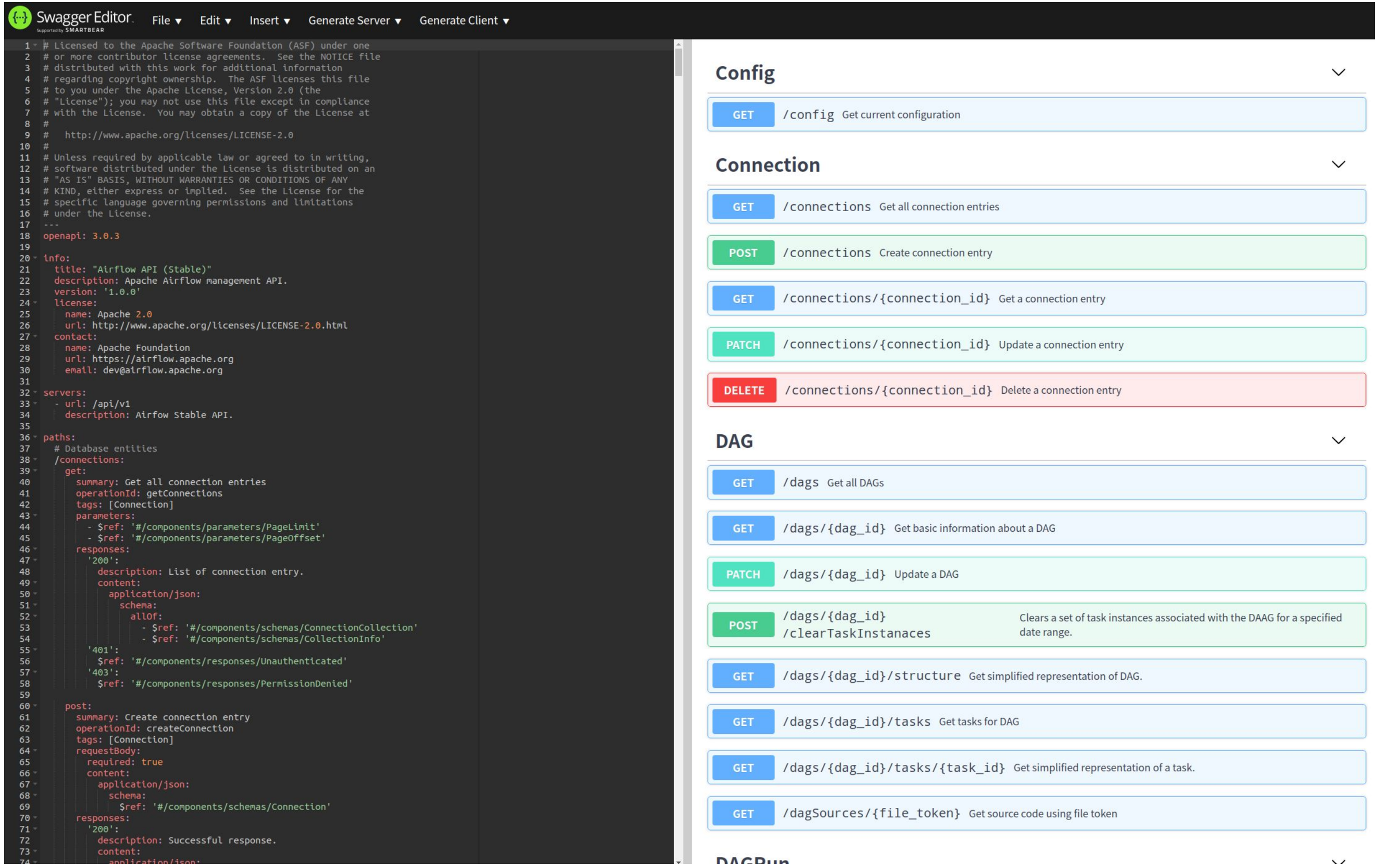
	Postgres		**Redis**	
	Before	After	Before	After
Average time	3.1 s	27.825 ms	778.557 ms	3.417 ms
Queries count	5000	1	5000	1

How to avoid regression?

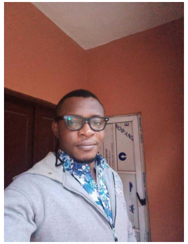
```python
with assert_queries_count(3):
    DAG.bulk_sync_to_db(dags)
```

REST API

API: follows Open API 3.0 specification



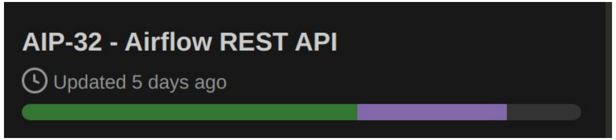
Outreachy interns



Ephraim Anierobi

Omair Khan

API development progress



	API Endpoints - Read - Connection #8127	Done
	API Endpoints - Read - DAG Model #8128	Community review
	API Endpoints - Read - DAG Runs #8129	Done
	API Endpoints - Read - Task Instance #8132	Development in progress
	API Endpoints - Read - Variable #8133	Done
	API Endpoints - Read - XCOM #8134	Done
	API Endpoint - Dag source #8137	Community review
	API Endpoint - Dags structure/Task #8138	Done
Community tasks		
High level info #8107		
Basic OpenAPI spec #8108		Done
Basic integration Airflow and connexion #8109		Done
API Endpoints #8118	API Endpoints - CRUD - Connection #8127	Done
	API Endpoints - CRUD - DAG Model #8128	Blocked
	API Endpoints - CRUD - DAG Runs #8129	Development in progress
	API Endpoints - CRUD - Import errors #8130	Done
	API Endpoints - CRUD - Pools #8131	Done
	API Endpoints - CRUD - Task Instance #8132	Blocked
	API Endpoints - CRUD - Variable #8133	Done
	API Endpoints - CRUD - XCOM #8134	Development in progress
	API Endpoint - Logs #8135	Done
	API Endpoint - Config #8136	Done
	API Endpoint - Dags structure/Task #8138	Done
	API Endpoint - Extra Links #8140	Done
		Next up
HATEOS for API #8117		Next up
CRUD Framework for API #8116		Next up
Authorization and Permissions #8112		Next up
Authentication in API #8111		Next up
Custom WEB UI screen to control permissions #8124		Blocked
Docs for REST API #8143		Research in progress
API security tests #8113		Blocked

Dev/CI environment

CI environment

- Moved to GitHub Actions
  - Kubernetes Tests ✅
  - Easier way to test Kubernetes Tests locally ✅
- Quarantined tests
  - Fixing the Quarantined tests ✅
- Thinning CI image
  - Moved integrations out of the image ✅
- Future: Automated System Tests (AIP-21)

Dev environment

- Breeze
  - unit testing ✅
  - package building ✅
  - release preparation ✅
  - kubernetes tests ✅
  - refreshed videos ✅
- Code Spaces / VSCode

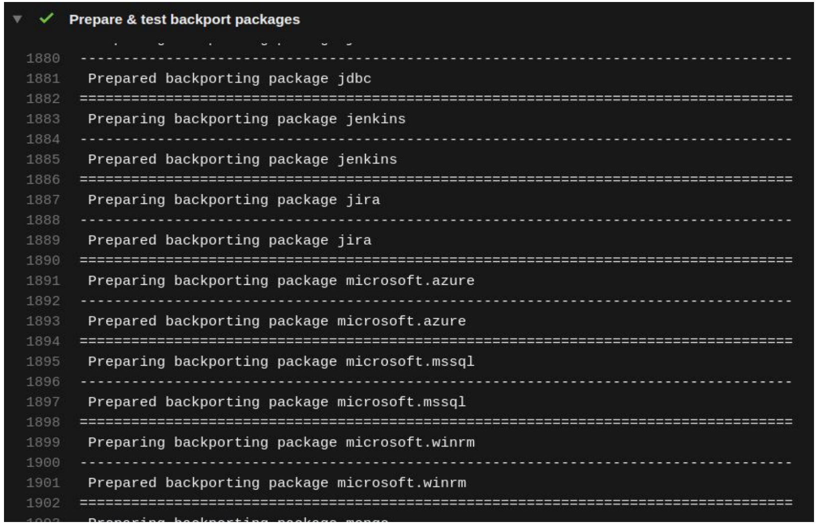
```
Usage: breeze [FLAGS] [COMMAND] -- <EXTRA_ARGS>

By default the script enters IT environment and drops you to bash shell, but you can choose one
of the commands to run specific actions instead. Add --help after each command to see details:

Commands without arguments:

  shell                                     [Default] Enters interactive shell in the container
  build-docs                                Builds documentation in the container
  build-image                               Builds CI or Production docker image
  cleanup-image                             Cleans up the container image created
  exec                                      Execs into running breeze container in new terminal
  generate-requirements                     Generates pinned requirements for pip dependencies
  push-image                                Pushes images to registry
  initialize-local-virtualenv               Initializes local virtualenv
  setup-autocomplete                        Sets up autocomplete for breeze
  stop                                      Stops the docker-compose environment
  restart                                   Stops the docker-compose environment including DB cleanup
  toggle-suppress-cheatsheet                Toggles on/off cheatsheet
  toggle-suppress-asciiart                  Toggles on/off asciiart

Commands with arguments:

  docker-compose                  <ARG>     Executes specified docker-compose command
  kind-cluster                    <ARG>     Manages KinD cluster on the host
  prepare-backport-readme         <ARG>     Prepares backport packages readme files
  prepare-backport-packages       <ARG>     Prepares backport packages
  static-check                    <ARG>     Performs selected static check for changed files
  tests                           <ARG>     Runs selected tests in the container

Help commands:

  flags                                     Shows all breeze's flags
  help                                      Shows this help message
  help-all                                  Shows detailed help for all commands and flags
```

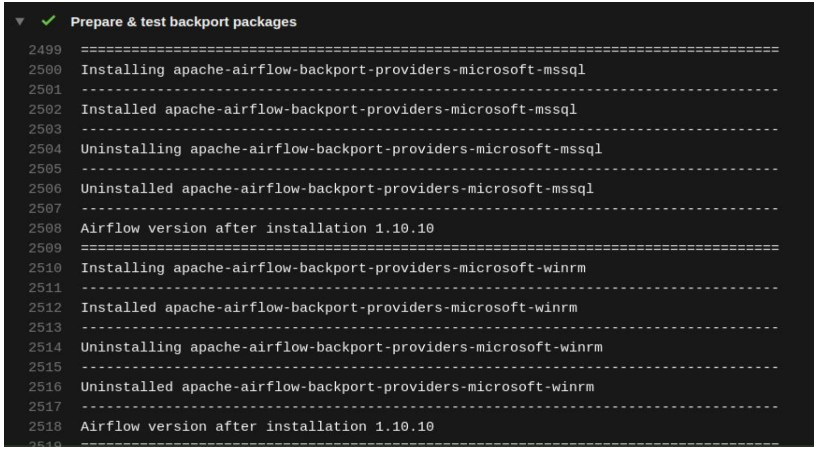
Backport Packages ✅

- Bring Airflow 2.0 providers to 1.10.* ✅
- Packages per-provider ✅
- 58 packages (!) ✅
- Python 3.6+ only(!) ✅
- Automatically tested on CI ✅
- Future
  - Automated System Tests (AIP-4)
  - Split Airflow (AIP-8)?

Talk: Migration to Airflow backport providers, Anita Fronczak

Thursday July 16th, 4 am UTC

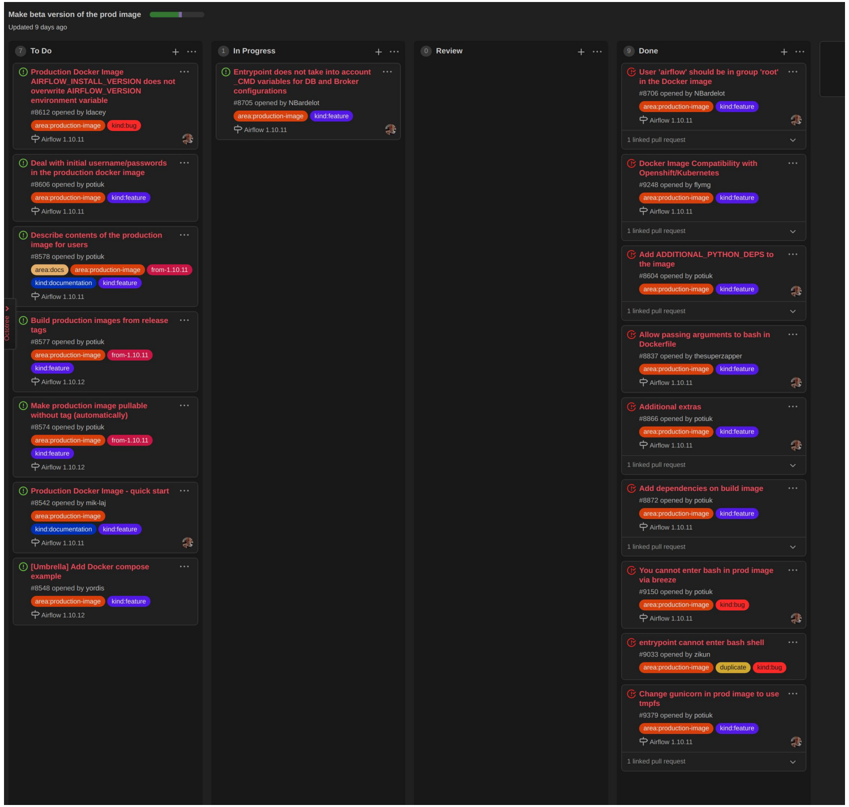




Support for Production Deployments

Production Image

- Beta quality image is nearly ready ✅
- Started with “bare image” ✅
- Listened to use cases from users ✅
- Integration with Helm Chart ✅
- Implemented feedback ✅
- Docker Compose



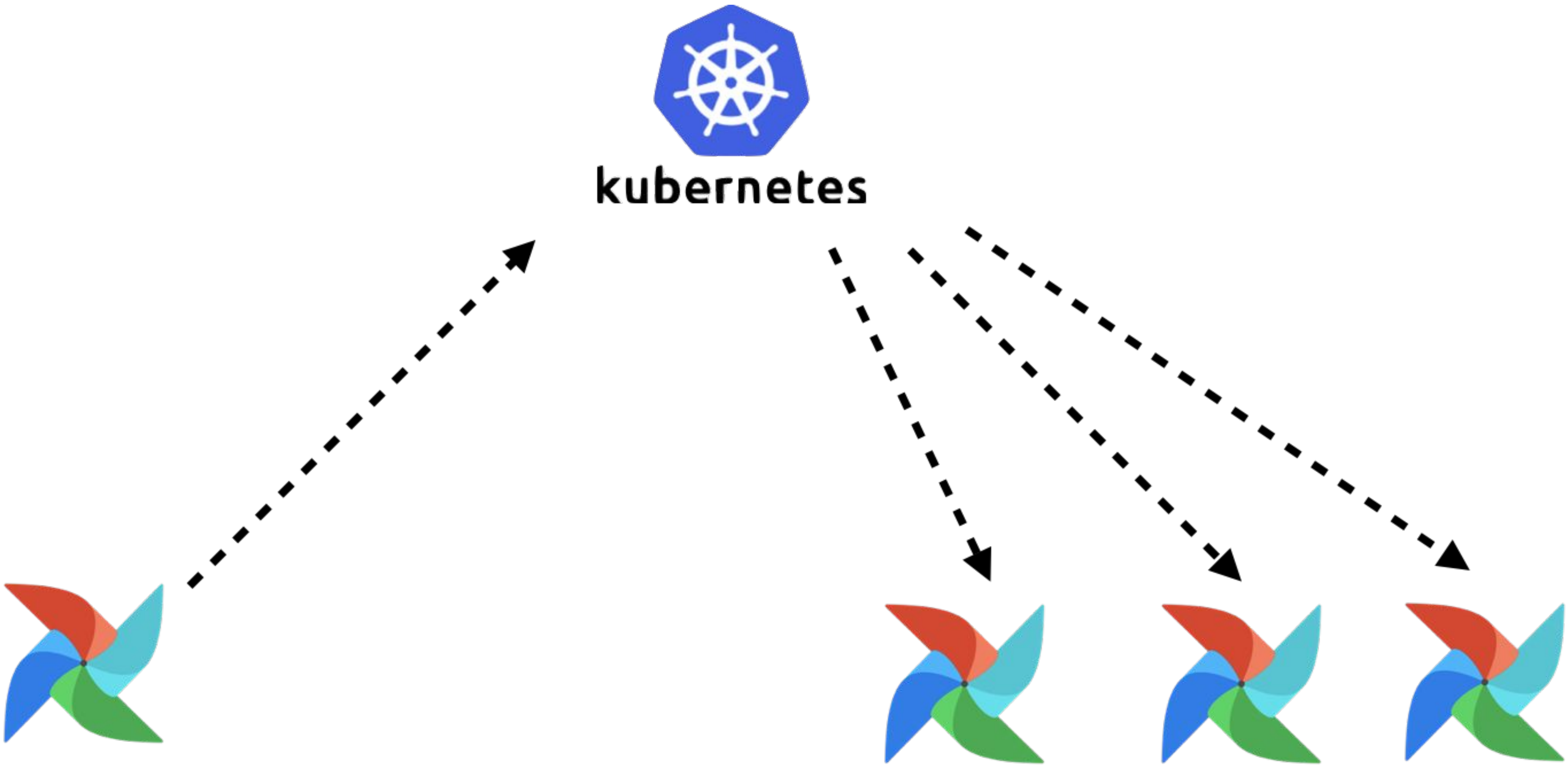
Talk, Production Docker image for Apache Airflow

Jarek Potiuk, Tuesday July 14th, 5 am UTC

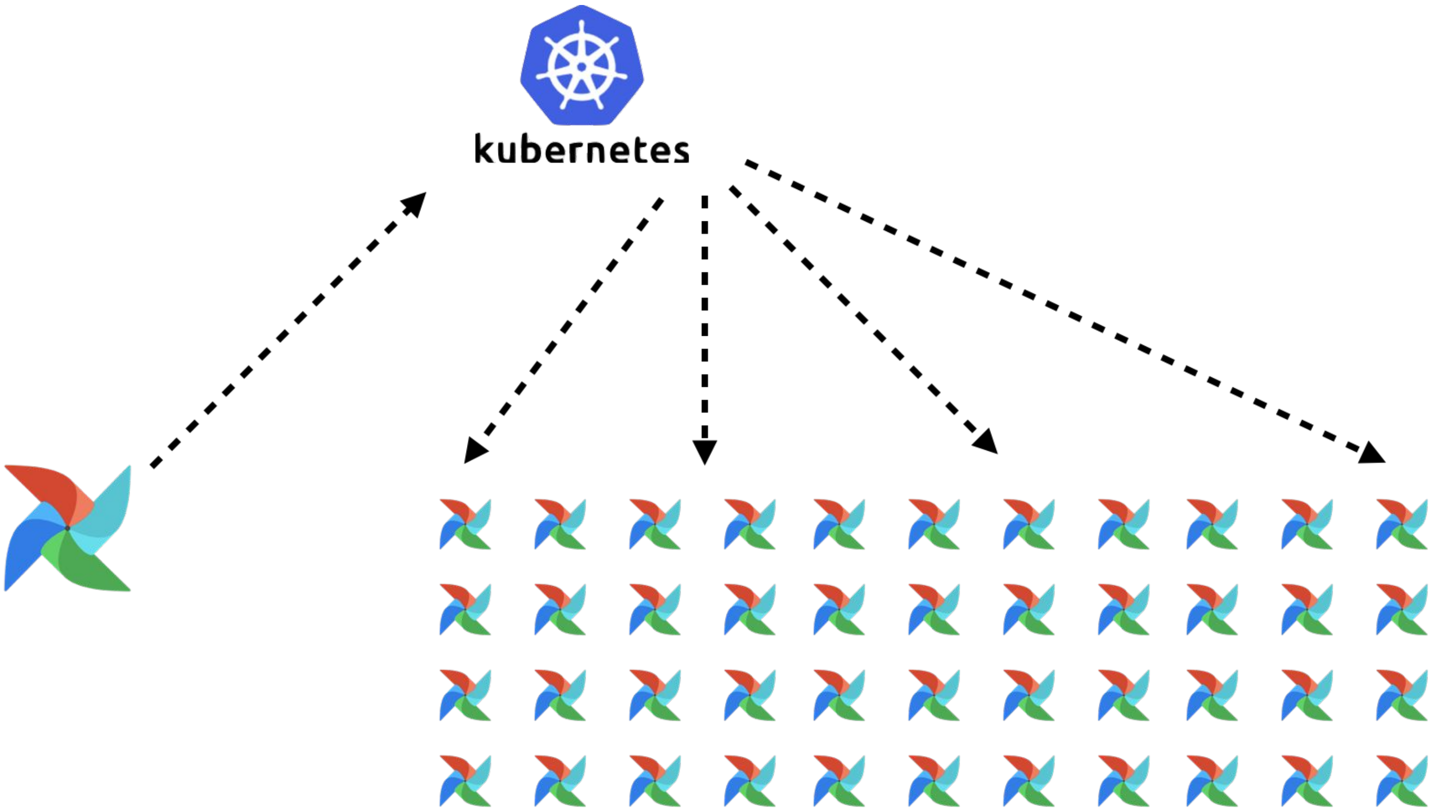
What’s new in
Airflow + Kubernetes

KEDA Autoscaling

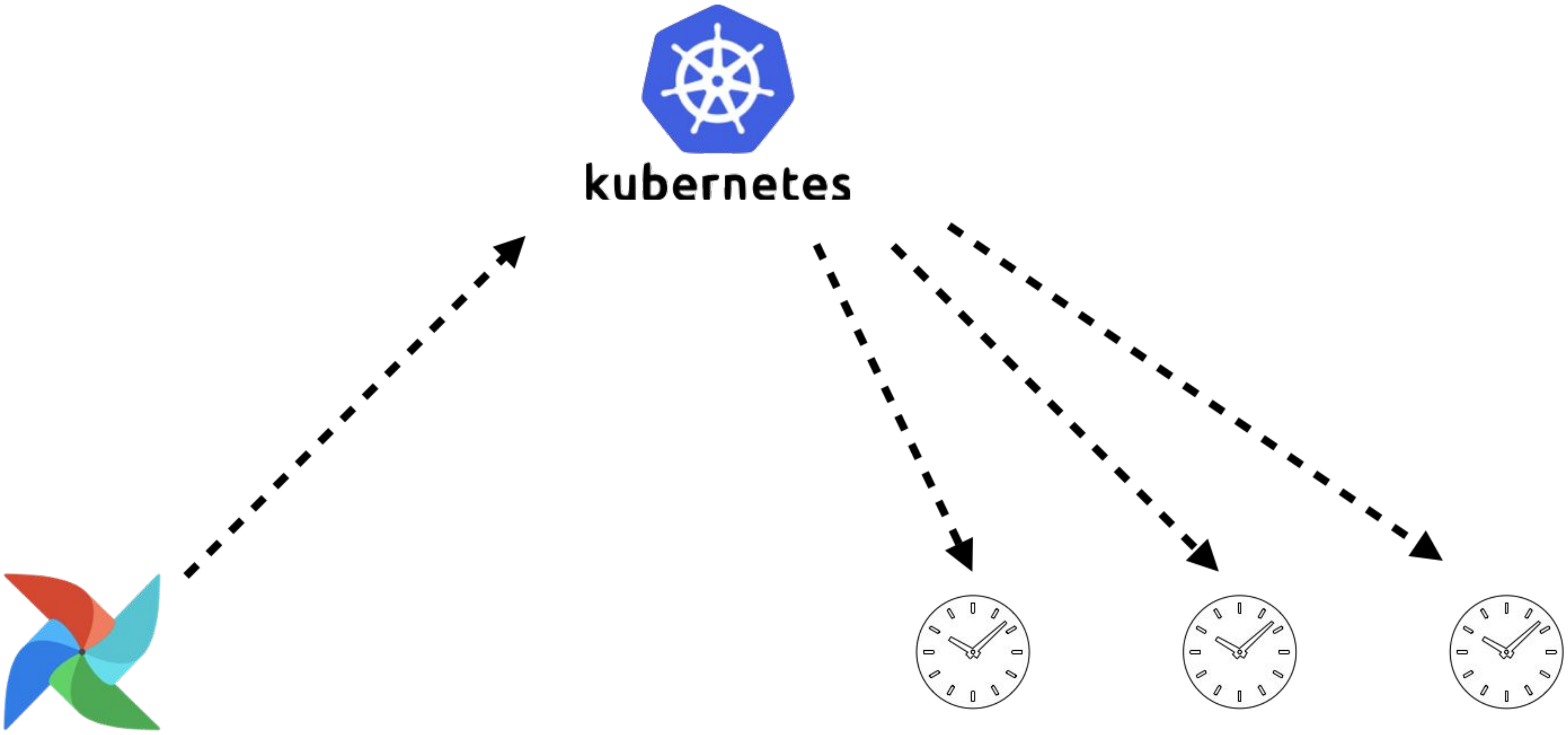
KubernetesExecutor



KubernetesExecutor



KubernetesExecutor



KubernetesExecutor vs. CeleryExecutor

KubernetesExecutor

- Dynamic Allocation
- executor_config

CeleryExecutor

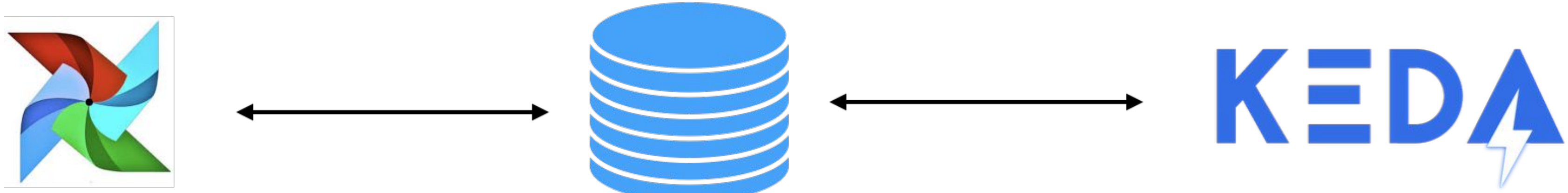
- Immediate SLAs
- Multiple tasks per-worker

KEDA

KEDA Autoscaling

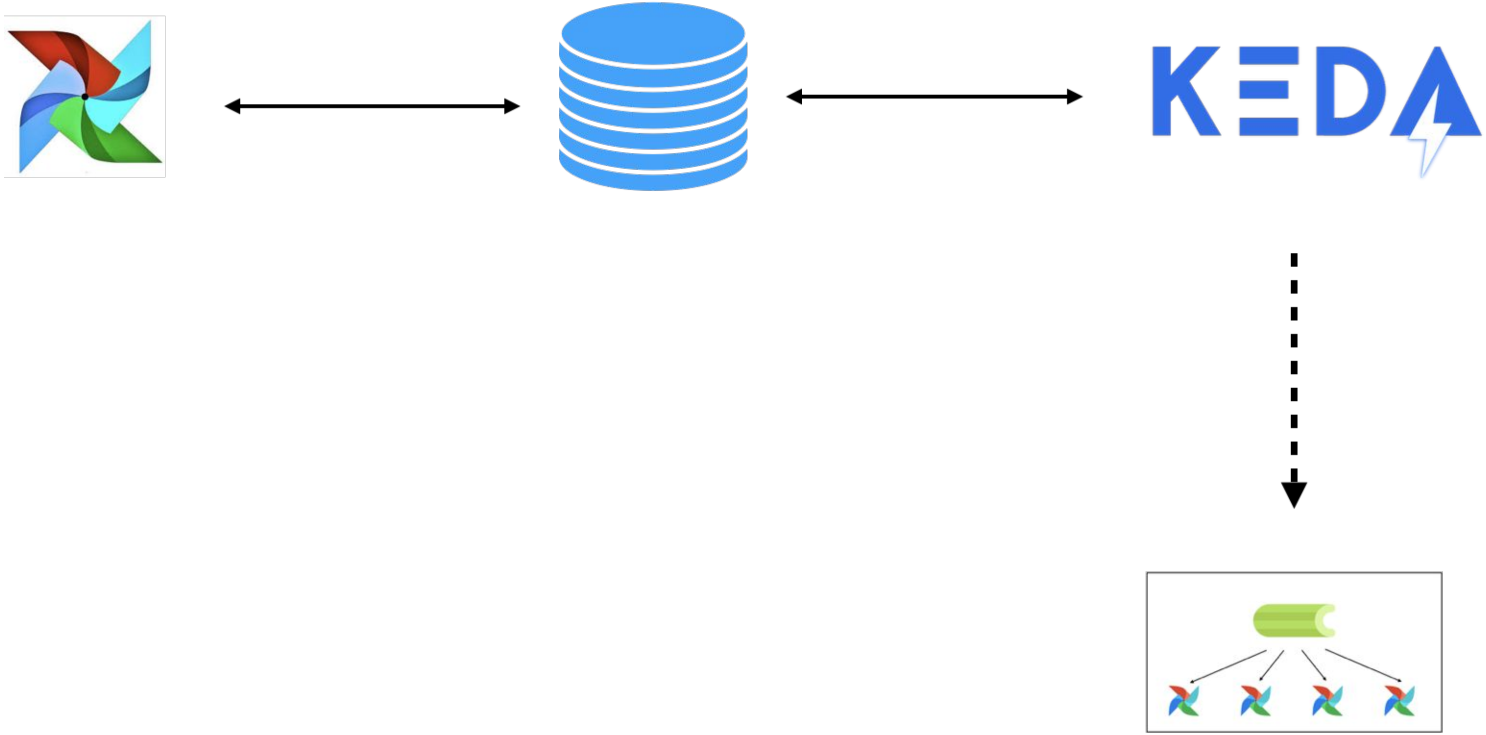
- Kubernetes Event-driven Autoscaler
- Scales based on # of RUNNING and QUEUED tasks in PostgreSQL backend

KEDA Autoscaling



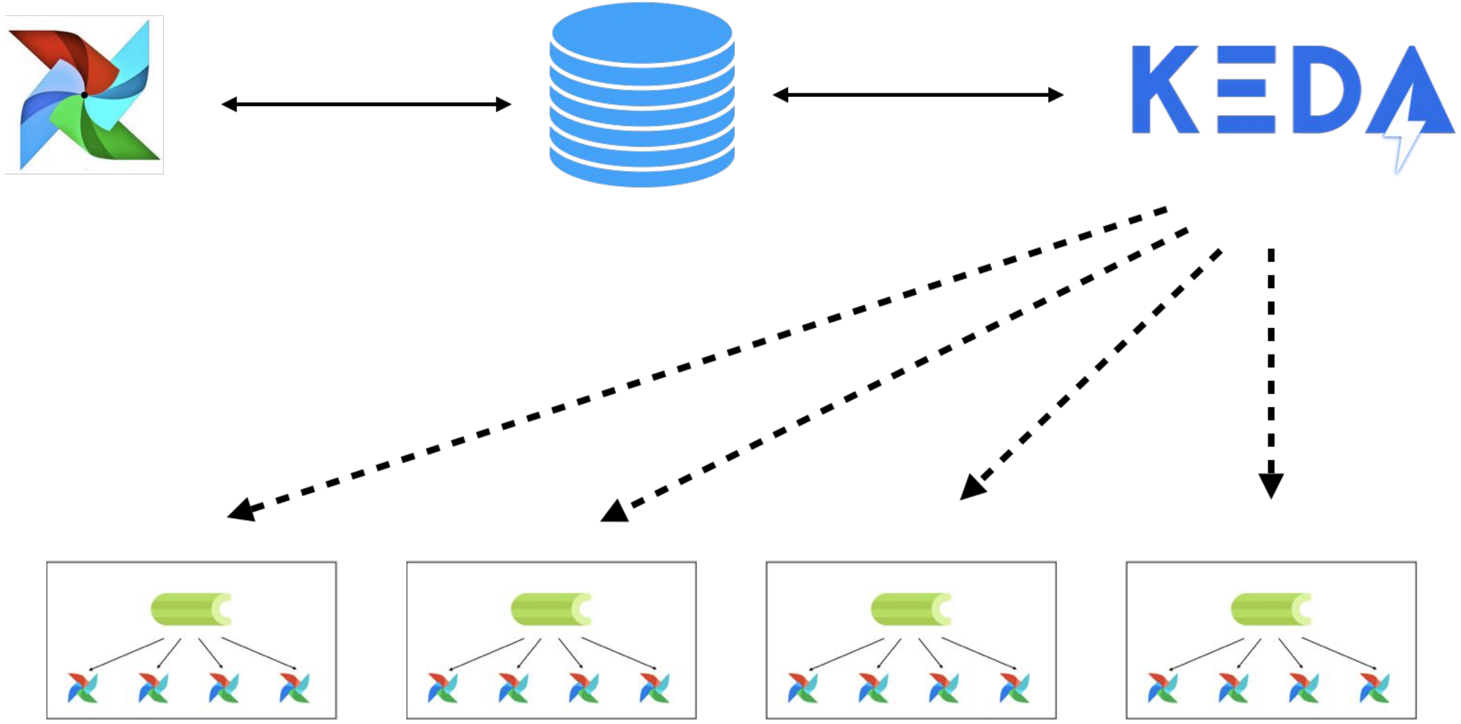
CEIL((0 RUNNING + 0 QUEUED)/16) = 0 workers

KEDA Autoscaling



CEIL((0 RUNNING + 1 QUEUED)/16) = 1 workers

KEDA Autoscaling



CEIL((20 RUNNING + 20 QUEUED)/16) = 4 workers

KEDA Queues

- Historically Queues were expensive and hard to allocate
- With KEDA, queues are free! (can have 100 queues)
- KEDA works with k8s deployments so any customization you can make in a k8s pod, you can make in a k8s queue (worker size, GPU, secrets, etc.)

KubernetesExecutor
Pod Templating from
YAML/JSON

KubernetesExecutor Pod Templating

- In the K8sExecutor currently, users can modify certain parts of the pod, but many features of the k8s API are abstracted away
- We did this because at the time the airflow community was not well acquainted with the k8s API
- We want to enable users to modify their worker pods to better match their use-cases

KubernetesExecutor Pod Templating

- Users can now set the pod_template_file config in their airflow.cfg
- Given a path, the KubernetesExecutor will now parse the yaml file when launching a worker pod
- Huge thank you to @davlum for this feature

Official Airflow Helm Chart

Helm Chart

- Donated by astronomer.io.
- This is the official helm chart that we have used both in our enterprise and in our cloud offerings (thousands of deployments of varying sizes)
- Helm 3 compliant
- Users can turn on KEDA autoscaling through helm variables
- “helm install apache/airflow”

Helm Chart

- Chart will cut new releases with each airflow release
- Will be tested on official docker image
- Significantly simplifies airflow onboarding process for Kubernetes users

Functional DAGs

Functional DAGs

```python
def get_cat_pictures(num: int) -> List[Dict]:
    response = requests.get("https://cat_pictures.com", params={"num": num})
    return response.json()["cats"]

def save_cats(list_of_cats: List[Dict]) -> None:
    for cat in list_of_cats:
        save_it_somehow(cat)

with DAG("cat_fetcher"):
    get_task = PythonOperator(
      task_id="get_task", python_callable=get_cat_pictures, op_args=[42]
    )
    cats = "{{ task_instance.xcom_pull('get_task') }}"
    save_task = PythonOperator(
      task_id="save_task", python_callable=save_cats, op_args=[cats]
    )
    get_task >> save_task
```

- ➔ PythonOperator boilerplate code
- ➔ Define separately:
  - ◆ order relation
  - ◆ data relation
- ➔ Writing jinja strings by hand

Functional DAGs

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def get_cat_pictures(num: int) -> List[Dict]:
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    )
    get_task >> save_task
```

```python
@task
def get_cat_pictures(num: int) -> List[Dict]:
    response = requests.get("https://cat_pictures.com", params={"num": num})
    return response.json()["cats"]

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with DAG("cat_fetcher"):
    get_task = get_cat_pictures(42)
    save_task = save_cats(get_task)
```

Data and order relationship are same!

And works for all operators

Functional DAGs

Data and order relationship are same!

And works for all operators

AIP-31: Airflow functional DAG definition

- Easy way to convert a function to an operator
- Simplified way of writing DAGs
- Pluggable XCom Storage engine

```python
@task
def get_cat_pictures(num: int) -> List[Dict]:
    response = requests.get("https://cat_pictures.com", params={"num": num})
    return response.json()["cats"]

@task
def save_cats(list_of_cats: List[Dict]) -> None:
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with DAG("cat_fetcher"):
    get_task = get_cat_pictures(42)
    save_task = save_cats(get_task)
```

Example: store and retrieve DataFrames on GCS or S3 buckets without boilerplate code

Find out more:

[AIP-31: Airflow functional DAG definition]

by Gerard Casas Saez

10th of July

Smaller changes

Other changes of note

- Connection IDs now need to be unique (#8608)

  It was often confusing, and there are better ways to do load balancing

- Python 3 only ✅

  Python 2.7 unsupported upstream since Jan 1, 2020

- "RBAC" UI is now the only UI ✅

  Was a config option before, now only option. Charts/data profiling removed due to security risks

Road to Airflow 2.0

When will Airflow 2.0 be available?

Airflow 2.0 – deprecate, but (try) not to remove

- Breaking changes should be avoided where we can – if upgrade is to difficult users will be left behind
- Release "backport providers" to make new code layout available "now":

```
pip install apache-airflow-backport-providers-aws  \
            apache-airflow-backport-providers-google
```

- Before 2.0 we want to make sure we've fixed everything we want to remove or break.

How to upgrade to 2.0 safely

- Install the latest 1.10 release
- Run `airflow upgrade-check` (doesn't exist, yet #8765)
- Fix any warnings
- Upgrade Airflow

Thank you!

Time for Q & A